UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT AND REPRODUCTIVE BIOLOGY OF THE BAMBOO BORER, *Dinoderus minutus* Fabricius (COLEOPTERA: BOSTRYCHIDAE)

NORHISHAM AHMAD RAZI

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By

NORHISHAM AHMAD RAZI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

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DEDICATIONS

I would like to dedicate this thesis to my father, Ahmad Razi Bin Othman, for instilling a curiosity for science and learning; to my sisters and brothers for encouraging me and convincing me to believe in myself and for always believing in me even when I did not; my fiancée, Rosnidawati Said, for being my friend supporting me in all of my endeavors; and most especially to my mother, Zainab Binti Adzid, who always believed in me and made it all possible.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

DEVELOPMENT AND REPRODUCTIVE BIOLOGY OF THE BAMBOO BORER, *Dinoderus minutus* Fabricius (COLEOPTERA: BOSTRYCHIDAE)

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Chairperson: Assoc. Prof. Faizah Abood, PhD

Faculty: Faculty of Forestry

Infestation by the bamboo borer, *Dinoderus minutus* on felled culms and bamboo products is a serious problem in the bamboo industry worldwide particularly in Malaysia. However, biological studies concerning *Dinoderus* spp. is very scarce in spite of the great economic importance of this problem. Since bamboo is very susceptible to borers this project is conducted to examine and investigate the development and reproductive aspects of the bamboo borer, *D. minutus*. Developmental stages of *D. minutus* on bamboo block of *Gigantochloa scortechinii* shows a significant difference ($p<0.01$) in boring capacity and lifespan of adult beetle at different moisture content tested. Infestation can occur from early felling of bamboo and it became severe as moisture content decreased to 15% moisture content. Overall life cycle recorded for *D. minutus* from egg to adult stage in bamboo was 98.28±1.26 days. Establishment of culture on nutrient rich diet showed cassava (*Manihot esculenta*) as a suitable culture

medium for *D. minutus* with continuous emergence of newly emerged beetle throughout the rearing period. *C*ontinuous emergence of newly emerged beetles started from day 90 onwards throughout the rearing period. Observation on sexual characteristics of *D. minutus* showed no sexual differences in adult beetle. Sexual identification was noticed in the terminal abdominal segment of pupa. Gonapophyses, comprising a pair of conical extrusions were present at the terminal abdominal segment in the female pupa whilst a pair of parameres was observed in the male. These morphological characteristics which was identified only in the pupal stage, proved to be the most reliable method to determine the sex of *D. minutus*. Ovipositional characteristics of *D. minutus* from population reared on bamboo and cassava showed no significant difference ($p \geq 0.05$) for pre-ovipositional and ovipositional period between female beetles from both culture. However, there was a significant difference ($p < 0.05$) in total egg laid per female per lifespan. Female beetle from cassava produced higher egg per lifespan due to longer ovipositional period. Egg incubation varied from fourth to sixth day with a mean period of 5.21±0.22 days. Egg development was observed to be prominent on third day with yolk globules becoming tightly packed taking the form of larvae. Hatchability of egg was 61.5%±1.24 from 100 eggs collected. Study on larval development of *D. minutus* using individual rearing method on different powder-state diet resulted with highest number of succeeding instar into pupal stage in cassava flour. Five classes of head capsule were obtained indicating five moults from first instar to pupa with a mean duration of 52.8±0.31 days. There were significant difference ($p < 0.01$) for head capsule width, larval body length and weight, and duration for different instars. Detailed information provided on the development and reproductive biology of *D. minutus* will

serve as a basis for a deeper understanding of its biological development before proper control management can be established.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan Ijazah Master Sains

PERKEMBANGAN DAN KESUBURAN BUBUK BULUH, *Dinoderus minutus* Fabricius (COLEOPTERA: BOSTRYCHIDAE)

Oleh

NORHISHAM BIN AHMAD RAZI

Januari 2012

Chairperson: Prof. Madya Faizah Abood, PhD

Faculty: Fakulti Perhutanan

Serangan bubuk buluh, *Dinoderus minutus* ke atas batang dan produk buluh merupakan satu masalah utama dalam industri buluh di dunia terutamanya di Malaysia. Sungguhpun impak ekonomi ini besar, rujukan tentang kajian biologi spesies ini pula masih sedikit. Projek ini dijalankan kerana buluh terdedah kepada serangan bubuk. Dalam kajian ini maklumat terperinci mengenai aspek-aspek perkembangan dan pembiakan *D. minutus* telah diperolehi. Perkembangan *D. minutus* pada kandungan kelembapan yang berbeza dalam blok buluh daripada spesies *Gigantocholoa schortechinii* menunjukkan perbezaan signifikan ($p<0.01$) terhadap kapasiti korekan dan umur kumbang dewasa pada kadar kelembapan yang diuji. Serangan boleh bermula daripada peringkat awal tebangan dan menjadi semakin serius apabila kadar kelembapan berkurangan mencapai kandungan kelembapan 15%. Kitar hidup yang direkodkan bagi *D. minutus* yang bermuladaripada peringkat telur ke dewasa di dalam buluh adalah 98.28±1.26 hari. Penghasilan medium pengkulturan daripada diet yang kaya nutrien menunjukkan ubi kayu sebagai satu

medium yang sesuai untuk *D. minutus* dengan kesinambungan generasi kumbang dewasa sepanjang tempoh pengkulturan. Kesinambungan generasi kumbang dewasa bermula pada hari ke-90 sewaktu tempoh kultur. Pemerhatian pada *D. minutus* menunjukkan peringkat kumbang dewasa tidak mempunyai perbezaan ciri seksual. Ciri seksual dikenalpasti di bahagian hujung abdomen pada peringkat pupa. Gonafofisis, yang terdiri daripada sepasang unjuran konikal terletak di segmen terminal pada pupa betina dan sepasang paramer terletak pada pupa jantan. Ciri morfologi seksual ini yang hanya dikenalpasti pada peringkat pupa merupakan kaedah yang terbaik bagi menentukan jantina *D. minutus*. Kesuburan *D. minutus* daripada kultur populasi buluh berbanding ubi kayu menunjukkan tiada perbezaan signifikan ($p \geq 0.05$) bagi tempoh pra-kesuburan dan kesuburan antara kedua-dua populasi tersebut. Walau bagaimanapun, terdapat perbezaan yang signifikan ($p < 0.05$) bagi kadar pengeluaran telur bagi setiap kumbang betina dalam kitar hidup. Kumbang betina daripada populasi ubi kayu menghasilkan telur yang lebih banyak disebabkan tempoh kesuburan yang lebih panjang. Tempoh inkubasi telur mengambil tempoh masa di antara empat ke enam hari dengan purata tempoh 5.21±0.22 hari. Perkembangan telur semakin jelas pada hari ketiga apabila globul-globul yolka menjadi padat mengambil bentuk larva. Peratus penetasan telur yang direkodkan adalah 61.5%±1.24 daripada 100 telur yang dikaji. Kajian perkembangan larva *D. minutus* menggunakan teknik penyelenggaraan larva secara individu menunjukkan peratus hidup yang paling tinggi pada serbuk ubi kayu daripada peringkat larva ke pupa. Lima kumpulan kapsul kepala diperolehi menunjukkan lima proses ekdises yang berlaku daripada instar pertama sehinggalah ke peringkat pupa dengan purata tempoh selama 52.8±0.31 hari. Terdapat perbezaan yang signifikan ($p < 0.01$) pada lebar sarung kepala, panjang dan berat larva dan tempoh bagi

setiap instar. Maklumat terperinci tentang biologi perkembangan dan pembiakan memainkan peranan penting untuk mendalami kefahaman mengenai biologi *D. minutus*. Ini pula akan menghasilkan pengawalan dan pengawasan yang lebih berkesan bagi perosak ini.

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And lastly, and most importantly, I would like to express my deepest gratitude to my family for the encouragement, prayer, support and attention throughout the course of this project. Thank you all!!! I hope I can always be there for you in the way you supported me!

I certify that an Examination Committee has met on **date of viva voce** to conduct the final examination of **Norhisham Ahmad Razi** on his thesis entitled **"Development and Reproductive Biology of The Bamboo Borer, *Dinoderus minutus* Fabricius (Coleoptera: Bostrychidae)"** in accordance with the universities and University Colleges Act 1971 and the Constitution of Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the senate of Universiti Putra Malaysia has been accepted as fulfillment of the requirement for the degree of Master Science. The members of the Supervisory Committee were as follows:

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I declare that the thesis is my original work except for quotations and citation, which has been duly acknowledged. I declare this thesis has not been previously and is not currently, submitted for any other degree at Universiti Putra Malaysia or other institutions.

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NORHISHAM AHMAD RAZI

Date: 26 January 2012

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
MC	Moisture content
SAS	Statistical Analysis System
SEM	Scanning Electron Micrograph